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(54) System for locating a mobile communication device

(57) A mobile communication device is disclosed, which, when being in a powered on state, is able to receive calls and, when being in a powered off state, is unable to receive calls. The device comprises a first radio receiver circuit, and a ringing mechanism for activating a ring signal in response to receiving, by means of the first radio receiver circuit, a call to the device, and a second radio receiver circuit, and means for activating the ringing mechanism when a code signal is received by the second radio receiver circuit independent on whether the device is in the powered on state or in the powered off state.

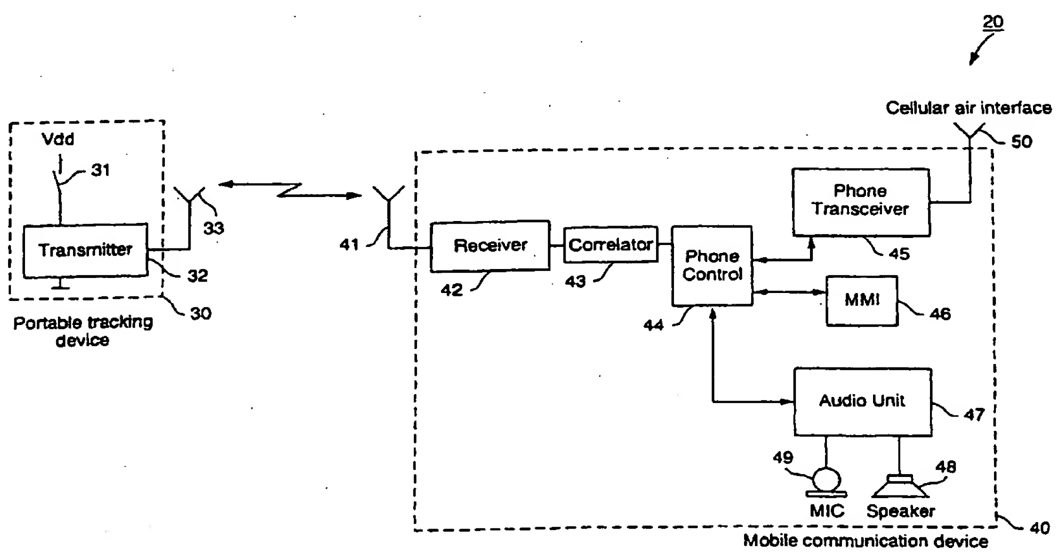

Fig. 2

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Description

TECHNICAL FIELD OF THE INVENTION

The invention relates to a mobile communication device and, in particular, to a mobile communication device which, when being in a powered on state, is able to receive calls and, when being in a powered off state, is unable to receive calls, and which comprises a radio receiver circuit and a ringing mechanism for activating a ring signal in response to receiving, by means of the radio receiver circuit, a call to the device. The invention also relates to a tracking system, and in particular, to a tracking system comprising a portable tracking device and a mobile communication device for tracking of the mobile communication device.

DESCRIPTION OF RELATED ART

With the large scale application of mobile phone networks, in particular the networks using the digital technology introduced in the beginning of the nineties, mobile communication devices, such as portable phones and cellular phones (also called: mobile phones), have become a widespread commodity. Although in the early days an article for the businessman only, nowadays mobile phones have entered the consumer market, providing phones to a large number of people for affordable prices.

Initially, the mobile phones were bulky and power-hungry devices. But in the last decade, mobile phones have been greatly improved. Today, phones are being developed with talk times of 2-3 hours and volumes of less than 100 cc. Phones as small as this can easily be carried around.

However, this also means that it becomes easy to misplace them. It will happen more and more that a phone has been placed in a coat pocket or a bag, and the owner has no idea where he placed it.

A first remedy to track a lost phone is to call its mobile number. However, this is only possible under the following conditions (which all have to be fulfilled at the same time). Firstly, the phone is powered on. Secondly, the ringing level is sufficient to be noticed. Thirdly, the phone is in the network coverage area. Fourthly, the batteries are sufficient to activate the phone. Especially the first two conditions are important. Since owners frequently power off their phones or minimises their ringing level in order not to be disturbed, these conditions are not always fulfilled.

Since it is not always possible to reach the phone through the cellular air interface, a new method must be found to track the misplaced phone.

One known system designed to prevent a user from leaving his mobile phone behind is disclosed in the Japanese Patent Application No. 5-95328, 'Portable Telephone Set'. A control signal generator, which is intended to be carried by the user of a mobile phone, transmits a control signal. The control signal is received by a receiver in the mobile phone. If the signal strength of the received control signal is less than a pre-set threshold level, an acoustic or visual warning signal is generated by the mobile phone. The idea is that this signal is generated to prevent a user from leaving his mobile phone behind.

The known system described above does have a number of disadvantages. Using the signal strength as indication does not provide a robust tracking method since the signal strength in wireless communication is severely hampered by so-called multipath or Rayleigh fading. When two radio paths enter the receiver at a 180 degree phase difference, a signal cancellation results and the signal strength drops by a large amount. In the known system, as described above, this gives rise to a warning signal from the mobile phone even when the user may be rather close to the mobile phone. Furthermore, the control signal generator needs to transmit the control signal at least at regular intervals to allow the mobile phone to sense the signal strength of the control signal. The control signal generator will therefore consume a non-negligible amount of power. This problem becomes even more acute considering that the control signal generator is supposed to be carried by the user and therefore needs to have small physical dimensions which does not allow a battery having a large capacity to be included. If a battery having small physical dimensions, and thereby a small capacity, is chosen the user needs to change or recharge the battery rather frequently. Furthermore, if the user wants to part from his phone, for example if he temporarily leaves a room, he must also leave the control signal generator with the phone to prevent the warning signal from being activated. When the control signal generator no longer is carried by the user the system can no longer prevent the user from leaving his phone behind.

The United States Patents Nos. 5,450,070 'Electronic Missing File Locator Systems', 4,101,873 'Device to Locate Commonly Misplaced Objects' and 4,476,469 'Means for Assisting in Locating an Object' refer to wireless tracking of misplaced objects. It is not disclosed, however, how these systems could be used for tracking mobile communication devices.

It is an object of the present invention to provide a mobile communication device and a tracking system for tracking a mobile communication device which overcomes or alleviates the above mentioned problems.

SUMMARY

According to an aspect of the present invention, there is provided a mobile communication device, which, when being in a powered on state, is able to receive calls and, when being in a powered off state, is unable to receive calls. The device comprises a first radio receiver circuit, and a ringing mechanism for activating a ring signal in response to receiving a call to the

device, by means of the first radio receiver circuit, and a second radio receiver circuit, and means for activating the ringing mechanism when a code signal is received by the second radio receiver circuit independent on whether the device is in the powered on state or in the powered off state.

According to a further aspect of the present invention, there is provided a tracking system comprising a portable tracking device and a mobile communication device. The portable tracking device comprises a radio transmitter for emitting a code signal on actuation by a user. The mobile communication device comprises, a first radio receiver circuit, and a ringing mechanism for activating a ring signal in response to receiving a call to the mobile communication device, by means of the first radio receiver, and means for setting the mobile communication device in a powered on state and a powered off state, corresponding to the mobile communication device being able and unable to receive calls, respectively, and a second radio receiver, and means for activating the ringing mechanism when the code signal is received by the second radio receiver independent on whether the mobile communication device is set in the powered on state or in the powered off state.

The mobile communication device and the tracking system achieve the advantages that the mobile communication device can be found even when it is in a powered off state. Furthermore, the portable tracking device consumes very little power as it is only activated when the user is trying to track the mobile communication device. Otherwise no power is consumed by the portable tracking device. A battery having a small capacity, and thereby small physical dimensions, can therefore be used which allows the portable tracking device to have small physical dimensions. Such a battery will still have a long life.

A further advantage is that the mobile communication device will not generate a ringing signal in case the mobile communication device is situated such that the signal strength from the portable tracking device drops due to Rayleigh fading as was the case for the known system described in the Japanese Patent Application No. 5-95328 above.

When a user is trying to track a prior art mobile phone by calling its number the problems are that the phone must be powered on. This problem is overcome by the present invention by providing means for activating the ringing mechanism when a code signal is received by the second radio receiver circuit independent on whether the device is in the powered on state or the powered off state. Another problem is that the phone needs to be in the network coverage area. This problem is overcome by the present invention by providing the second radio receiver. Since the second radio receiver circuit receives a code signal from the portable tracking device the device is tracked without involving the mobile network.

Referring to the prior art system described in the Japanese Patent Application No. 5-95328, the problem that false ringing signals are generated due to Rayleigh fading is overcome by the present invention because the portable tracking device does only transmit a radio signal when the user tries to track the mobile communication device. Thus, the tracking system of the present invention does not depend on a measured signal strength which may be hampered due to Rayleigh fading. The fact that the portable tracking device only transmits a radio signal when the user tries to track the mobile communication device also solves the problem of power consumption in the portable device. The power consumed will be much less compared to the power consumed by the control signal generator of the Japanese Patent Application No. 5-95328 which needs to transmit the control signal at least at regular intervals. A battery having a small capacity, and hence small physical dimensions, can therefore be used in the portable tracking device of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates an application example of a tracking system according to an embodiment of the present invention;

Fig. 2 illustrates a high-level block diagram of the tracking system according to an embodiment of the present invention;

Fig. 3 illustrates a timing diagram according to a preferred embodiment of the present invention;

Fig. 4 illustrates a block diagram of the transmitter of an embodiment of the present invention

Fig. 5 illustrates a block diagram of the receiver of an embodiment of the present invention;

Fig. 6 illustrates an example of a prior art dual-tone FM detector;

Fig. 7 illustrates an implementation example of a prior art sliding correlator.

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention relates to a mobile communication device comprising a first radio receiver and a ringing mechanism and which may be set in a powered on state and a powered off state. The mobile communication device may be a portable phone, such as a cellular phone, where the first radio receiver is connected to a first radio air interface, such as a cellular air interface. The mobile communication device may also be a pager where the first receiver is connected to a first radio air interface. In the powered on state, the device is able to receive calls by means of the first radio receiver. The ringing mechanism, which may generate an acoustic signal and/or a visual signal, and/or a mechanically generated vibration is/are activated when a received call is detected. In the powered off state, however, the device is not able to receive a call. To reduce the power consumption when the device is in the powered off state it

is customary to power off at least some parts of the device. The present invention also relates to a tracking system comprising a portable tracking device and a mobile communication device for tracking of the mobile communication device.

Fig. 1 illustrates an application example of a tracking system 10 according to an embodiment of the present invention. A second radio air interface is applied to track the mobile communication device. A low-cost, low-power, short-range radio transmitter, preferably implemented in a key (not shown) or a small unit 11 that can be hooked onto a key-ring. A push on the button 12 will result in a transmission of one or a sequence of short bursts that include a unique identity code. Preferably the transmitter uses an unlicensed RF band. The low-cost, low-power radio receiver present in the mobile communication device 13 scans the band periodically in search for the unique code. The mobile communication device comprises means which, independently on the device being in the powered off state or in the powered on state, can detect a radio code signal. Preferably the radio code signal is detected by a second radio receiver which is powered on at all times or, at least, at regular intervals. Upon the detection of the radio code signal the ringing mechanism of the device is activated and the device will thereby reveal its presence (indicated as 'BEEP'). In an alternative embodiment the detection of the radio code signal first sets the device in its powered on state before the ringing mechanism is activated. Preferably, the level of the ringing signal is automatically set at a high level when the radio code signal is detected to allow the phone to be retrieved even when the user has set the ringing level to a low level.

It should be noted that the tracking of a (misplaced) mobile phone is performed without relying on the first radio air interface. The tracking, however, needs to be wireless and cover an omni-directional search area. In addition, it needs to be able to penetrate light materials like clothing, plastic, and light walls. Therefore, the wireless tracking method makes use of radio signals. A low-cost, short-range radio transmitter worn by a person is able to send a message to the second radio receiver in the mobile phone in order to activate the ringing mechanism.

There is not much radio spectrum available for these kind of (private) applications. In the US, the ISM (Industrial, Scientific, Medical) bands at 900 MHz, 2.4 GHz, and 5.7 GHz are unlicensed, and can be used freely, provided the transmission, TX, power levels are low or spreading is applied. The 2.4 GHz band is even available globally. In order to avoid interference, spreading should be applied, either by frequency-hopping (FH) or direct-sequence (DS) spread spectrum. Because of the one-direction and bursty nature of the application, DS spread spectrum is more appropriate for the considered tracking method.

Fig. 2 illustrates a high-level block diagram of the tracking system 20 according to an embodiment of the present invention. The system comprises a portable tracking device 30 and a mobile communication device 40. The portable tracking device comprises a switch 31. Upon actuation of the switch by a user, a transmitter 32 is powered on and a sequence of short bursts is transmitted by means of an antenna 33. The transmission continues as long as the switch is closed. Each burst consists of a code word of N bits which is unique for each tracking system. In the mobile communication device, a second receiver 42 connected to a second antenna 41 scans the RF band continuously or periodically. The latter is preferred in order to reduce the duty cycle in the receiver and thus the current consumption. The second receiver is connected to a correlator 43. The output signal of the correlator is fed to a phone control unit 44. The phone control unit controls the activity of the mobile communication device 40. For example, it controls a phone transceiver 45, a Man-Machine-Interface, MMI, unit 46 and an audio unit 47. The transceiver, which includes a first radio receiver (not shown), is connected to a first antenna 50. The first antenna 50 constitutes the first radio air interface of the mobile communication device. The audio unit is connected to a microphone 49 and a speaker 48.

If the mobile communication device is set in a powered on state and an incoming call is received at the first antenna 50 and received by the first radio receiver of the phone transceiver 45 the phone control unit 44 activates either a buzzer (not shown) or the speaker 48. An audible ring signal is thereby generated. No incoming call can be detected if the mobile communication device is set in a powered off state.

When the phone control unit 44 receives a signal from the correlator 43 which indicates that the second receiver 42 has received the correct user code, the phone control unit activates either a buzzer (not shown) or the speaker 48. An audible ring signal is thereby generated in a manner similar to when an incoming call is detected. Preferably, the level of the ring signal is set to a high level independent on the level chosen by the user of the mobile communication device. Note that the second receiver and at least a part of the phone control unit are powered on at least during specified periods of times even when the mobile communication device is set in the powered off state (i.e. the mobile communication device is unable to receive calls through the first radio air interface) to be able to receive and respond to a transmitted user code.

Fig. 3 illustrates a timing diagram according to a preferred embodiment of the present invention. The topmost diagram, denoted 'switch', illustrates how the switch 31 is closed during a certain period of time. The diagram in the middle, denoted 'TX', illustrates that a number of identical codes are transmitted during the period of time the switch is closed. The diagram at the bottom, denoted 'RX', illustrates periods of time when the second receiver 42 scans the RF band (illustrated as 'scan'). Between the periods when the second

receiver scans the RF band it is turned off (illustrated as 'sleep'). Preferably, the scan lasts at least for a period corresponding to two code lenghts in order to guarantee the reception of an entire code. In Fig. 3 it is illustrated how the ring signal is activated after the second receiver has detected the correct code. If the codes are continuously transmitted during the period of time between two wake-up instances or longer, the transmitted signal will be detected by the second receiver if it is within a certain range of the transmitter. Preferably, the range of the tracking system is limited and it should not be larger than the range of the audible signal (e.g. 10 - 30 m).

For the implementation of the transmitter and the second receiver, simplicity (low-cost) and low current consumption (especially for the receiver) should be the major concerns. Preferably, both the transmitter and the second receiver consist of a single chip without any external components. The signals should preferably use phase or frequency modulation, so that the received signal can be hard-limited and no automatic gain control has to be applied. Non-coherent detection is preferred to avoid a costly receiver architecture. Finally, cheap frequency references place special requirements on the modulation scheme. The preferred modulation is a binary FSK scheme, and a dual-tone multi-frequency detector at the receiver should be used. Similar modulation and detection schemes are possible as will be recognised by those skilled in the art of radio design. The following description of a cheap radio system only serves as an example.

It is assumed that the 2.4 GHz ISM band is used for the phone tracking system. This band ranges from 2400 MHz to 2483.5 MHz. In order to avoid sharp filters to fulfil the out-of-band emission requirements, the applied radio band is preferably placed away from the ISM band edges. Known interference areas (like the section from 2435 MHz to 2465 MHz where micro-wave ovens are operating) are preferably avoided as well. FSK can be used to map the user code on the RF carrier. In the FSK modulation scheme, a bit representing 'one' is mapped to the frequency $f_{RF}+\Delta f$ and a bit representing 'zero' is mapped to the frequency $f_{RF}-\Delta f$ (the opposite is also possible) where f_{RF} is the carrier frequency. The frequency deviation Δf should be large enough to combat the frequency offset between transmitter and receiver. For example, if sloppy frequency references with an accuracy of ± 50 PPM (part per million) are used, the worst-case frequency offset can reach up to 240 kHz. In order to receive the burst in this case, the frequency deviation Δf should be larger than 240 kHz. The information rate should be chosen low to minimise power consumption. An example is to use a bit rate of 1 Mb/s. With a frequency deviation of Δf = 250 kHz, in fact MSK (Minimum Shift Keying) results. The length of a single burst then depends on the user code length. The user code is used directly as DS spreading code. The code word should be sufficiently long in order to minimise the false alarm rate in the receiver. On the other hand, a shorter burst gives a shorter correlator at the receiver. A code length of 64 can be used, provided special action at the receiver is taken to reduce the false alarm rate. This will be further discussed later. A sequential correlator as disclosed in the Swedish Patent Application No. 9601152-3, the contents of which is hereby incorporated by reference, may also be used to detect the code. Alternatively, the false alarm rate can be reduced by relying on several received codes in a row. An example of a transmitter implementation of a portable tracking device 30 is shown in Fig. 4. As long as current is supplied by closing the switch 31, a code generator 35 repetitively generates a sequence of symbols according to a user code which is stored in a separate register 34. The binary symbols are fed directly to a voltage-controlled oscillator, VCO, 36 operating somewhere in the 2.4 GHz band. Depending on the desired range, a power amplifier (not shown) might have to be added before the code signal is fed into the transmit antenna 33. The entire system is preferably built as an integrated circuit on a single chip.

In the second receiver 42 (Fig. 2), the signal has to be converted from RF to base band, and then it must be matched against the expected user code. A general block diagram is shown in Fig. 5. The antenna 41 is connected to a dual-tone FM detector 51. The output of the FM detector is connected to a correlator 43. The output signal of the correlator is denoted 'trigger'. A power control unit 52 is connected to the FM detector and the correlator. The power control unit activates the FM detector and the correlator during the periods of time when the receiver scans the RF band. There are several ways to achieve the RF to base band conversion. However, due to the requirements on cost (single chip) and low-power consumption, a dual-tone FM detector 51 as applied in pagers is used. A block diagram of the detector is presented in Fig. 6. A quadrature VCO 59 maps the input signal on an I and Q branch which operate at DC levels. Then low-pass filters 53, 54, (which are preferably implemented on a chip) can be used to filter out unwanted spurious. Thereafter a cross-coupled discriminator 55 follows. The signals on the I and Q branches are summed, in adder 56, and finally a low-pass filter 57 matched to the symbols is applied. The output is proportional to $f_{in}-f_{LO}$ where f_{in} is the instantaneous frequency of the input signal and f_{LO} is the local oscillator frequency in the receiver. Since the frequency deviation was chosen bigger than whatever frequency offset that can occur (assuming a maximum inaccuracy of ± 50 PPM), the signal can be hard-limited, by means of a limiter 58, at the detector output. Possible DC problems in the down-converter can be reduced by applying blocking capacitors (not shown). The effect on the signal can be reduced by decreasing the RF power at DC. This can be achieved by decreasing the information bit rate which results in an increase of the modulation index.

The hard-limited signals can be fed into a digital correlator 43 (Fig. 2, Fig. 5) which is matched to the

expected user code. This correlator has to slide over the received symbols, and is preferably implemented by a tapped delay line 60 as shown in Fig. 7. The coefficients a_i (i=0,...., N-1) are +1 or -1 and reflect the user code. The length of the delay line is identical to the length of the user code. The output of the correlator is an even value between -64 and +64. If all input symbols match the expected code, then the correlator output is 64. In case of noise, this will hardly ever happen, even if the correct code is received. Therefore, a threshold must be specified, i.e. for a correlator value below the threshold, no action is taken. A proper threshold must be chosen in order to have the best combination of false alarm (trigger given, but no code transmitted) and false reject (code transmitted but not recognised by receiver). Especially the false alarm rate must be low in order to avoid the ringing signal being activated by pure noise. The false alarm rate can be reduced by taking into account several trigger occasions. For example the phone control is only activated when two or more trigger events in a row of wake-up instances are experienced. When the phone control is activated, a ringing signal or other audible indication is produced by an audio unit in order to draw the attention.

Both the transmitter and the second receiver are preferably implemented in a single CMOS chip. Special attention to low-power operation in the second receiver is required. Only in the wake-up period should the receiver section be powered on. In the sleep period, only a low-power timer should be active to keep track of the sleep/wake timing.

The mobile communication device and the tracking system of the present invention achieve the advantages that the device can be found even when it is in a powered off state. Furthermore, the portable tracking device consumes very little power as it is only activated when the user is trying to track the mobile communication device. During the rest of the time no power is consumed by the portable tracking device. A battery having a small capacity, and thereby small physical dimensions, can therefore be used which allows the portable tracking device to have small physical dimensions.

A further advantage is that the mobile communication device will not generate a ringing signal in case the mobile communication device is situated such that the signal strength from the portable tracking device drops due to Rayleigh fading.

A further advantage is that the mobile communication device is tracked without involving the mobile network. There is therefore no need for the device to be in the network coverage area to be tracked.

Claims

1. A mobile communication device (13, 40), which, when being in a powered on state, is able to receive calls and, when being in a powered off state, is unable to receive calls, comprising:

   a first radio receiver circuit (45); and
   a ringing mechanism (44, 47, 48) for activating a ring signal in response to receiving, by means of the first radio receiver circuit, a call to the device; characterised in that the device further comprises:

      a second radio receiver circuit (42); and
      means (43, 44, 47, 48) for activating the ringing mechanism when a code signal is received by the second radio receiver circuit independent on whether the device is in the powered on state or in the powered off state.

2. A mobile communication device according to claim 1 wherein the second radio receiver circuit is periodically activated and deactivated, wherein the period of time the second radio receiver circuit is activated is sufficiently long to allow the code signal to be received completely.

3. A mobile communication device according to claim 1 or claim 2, wherein the second receiver circuit comprises a dual-tone multi-frequency detector, for detecting a binary FSK-coded signal.

4. A mobile communication device according to any one of the preceding claims, wherein the second radio receiver circuit, when activated, generates a sequence of received symbols, and wherein the second radio receiver circuit further comprises a digital correlator which slides over the received symbols and generates an output signal which depends on the correlation between a received sequence of symbols and the code signal.

5. A mobile communication device according to claim 4 wherein the digital correlator comprises a tapped delay line.

6. A mobile communication device according to claim 4 or claim 5 wherein the second radio receiver circuit further comprises means for comparing the output signal of the correlator with a pre-determined threshold value, and the means for activating the ringing mechanism activates the ringing mechanism when the output signal of the correlator exceeds the pre-determined threshold value.

7. A tracking system (10, 20) comprising a portable tracking device (11, 30) and a mobile communication device (13, 40) the portable tracking device comprising:

   a radio transmitter (32) for emitting a code signal on actuation by a user; and the mobile communication device comprising:

a first radio receiver circuit (45); and

a ringing mechanism (44, 47, 48) for activating a ring signal in response to receiving, by means of the first radio receiver, a call to the mobile communication device; and

means for setting the mobile communication device in a powered on state and a powered off state, corresponding to the mobile communication device being able and unable to receive calls, respectively; and

a second radio receiver (42); and

means (43, 44, 47, 48) for activating the ringing mechanism when the code signal is received by the second radio receiver independent on whether the mobile communication device is set in the powered on state or in the powered off state.

8. A tracking system according to claim 7 wherein the second radio receiver circuit is periodically activated and deactivated, wherein the period of time the second radio receiver circuit is activated is sufficiently long to allow the code signal to be received completely.

9. A tracking system according to claim 7 or claim 8 wherein the second receiver circuit comprises a dual-tone multi-frequency detector, for detecting a binary FSK-coded signal.

10. A tracking system according to any one of claim 7 to claim 9 wherein the second radio receiver circuit, when activated, generates a sequence of received symbols, and wherein the second radio receiver circuit further comprises a digital correlator which slides over the received symbols and generates an output signal which depends on the correlation between a received sequence of symbols and the code signal.

11. A tracking system according to claim 10 wherein the digital correlator comprises a tapped delay line.

12. A tracking system according to claim 10 or claim 11 wherein the second radio receiver circuit further comprises means for comparing the output signal of the correlator with a pre-determined threshold value, and the means for activating the ringing mechanism activates the ringing mechanism when the output signal of the correlator exceeds the pre-determined threshold value.

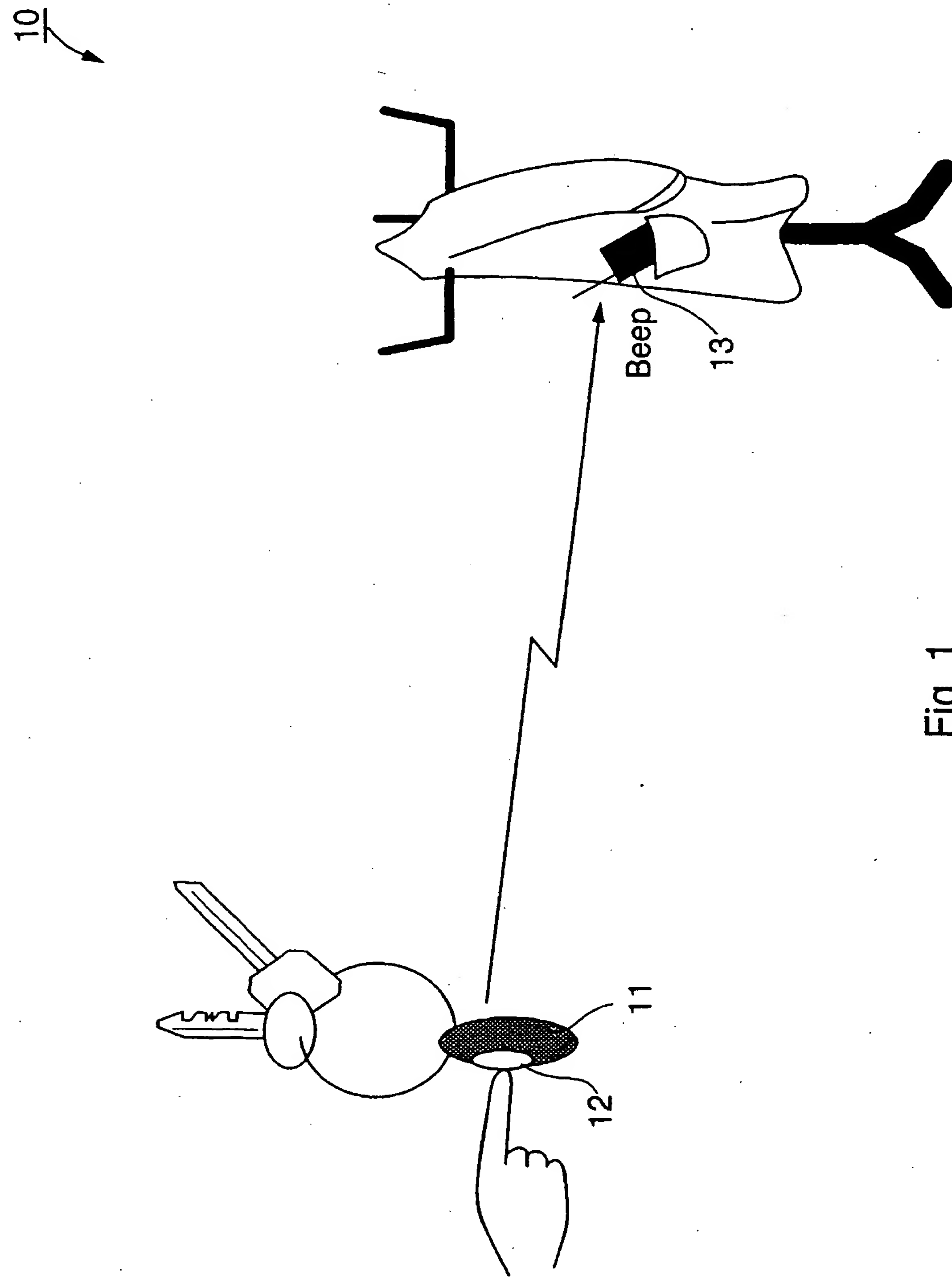
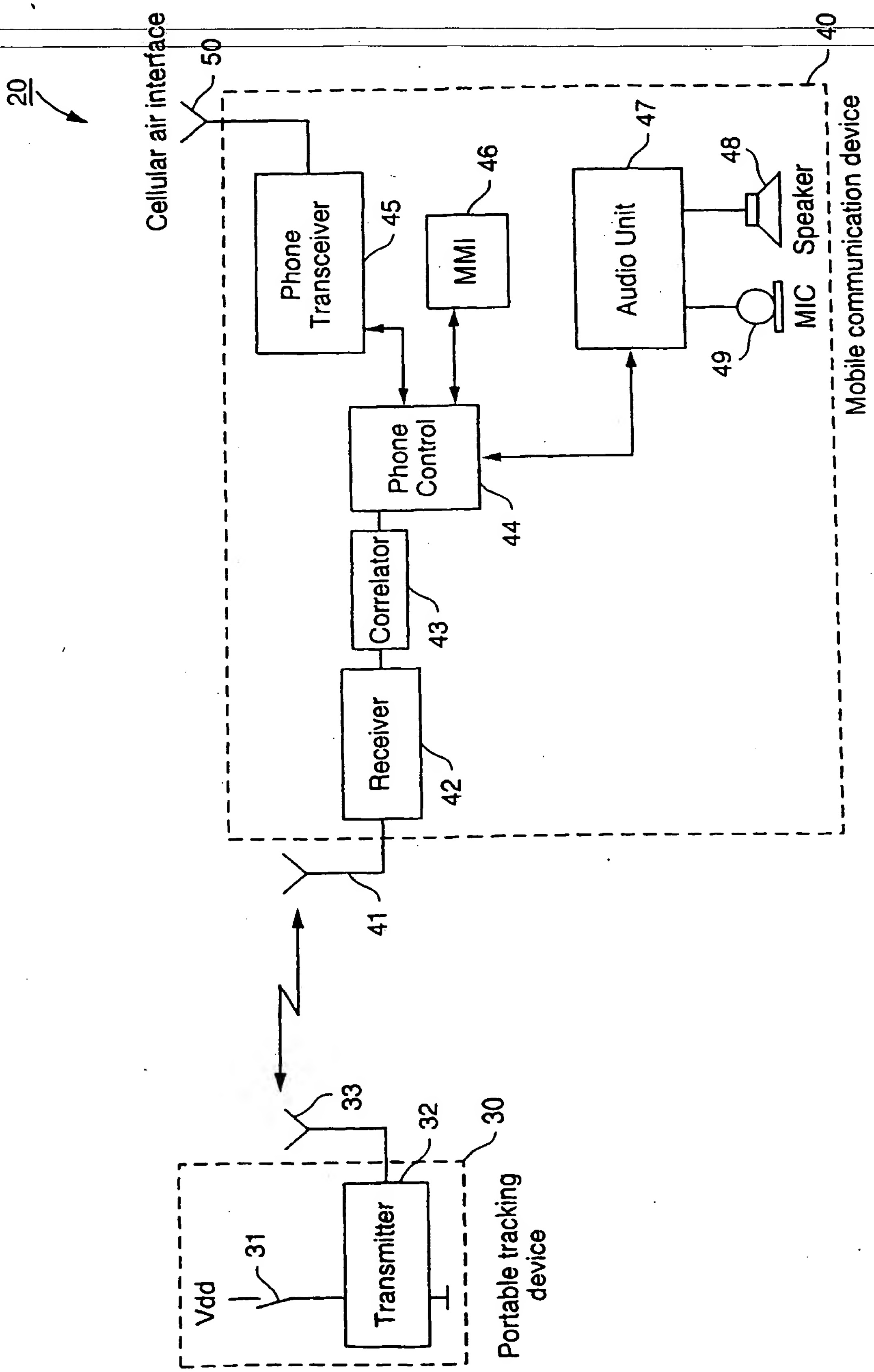


Fig. 1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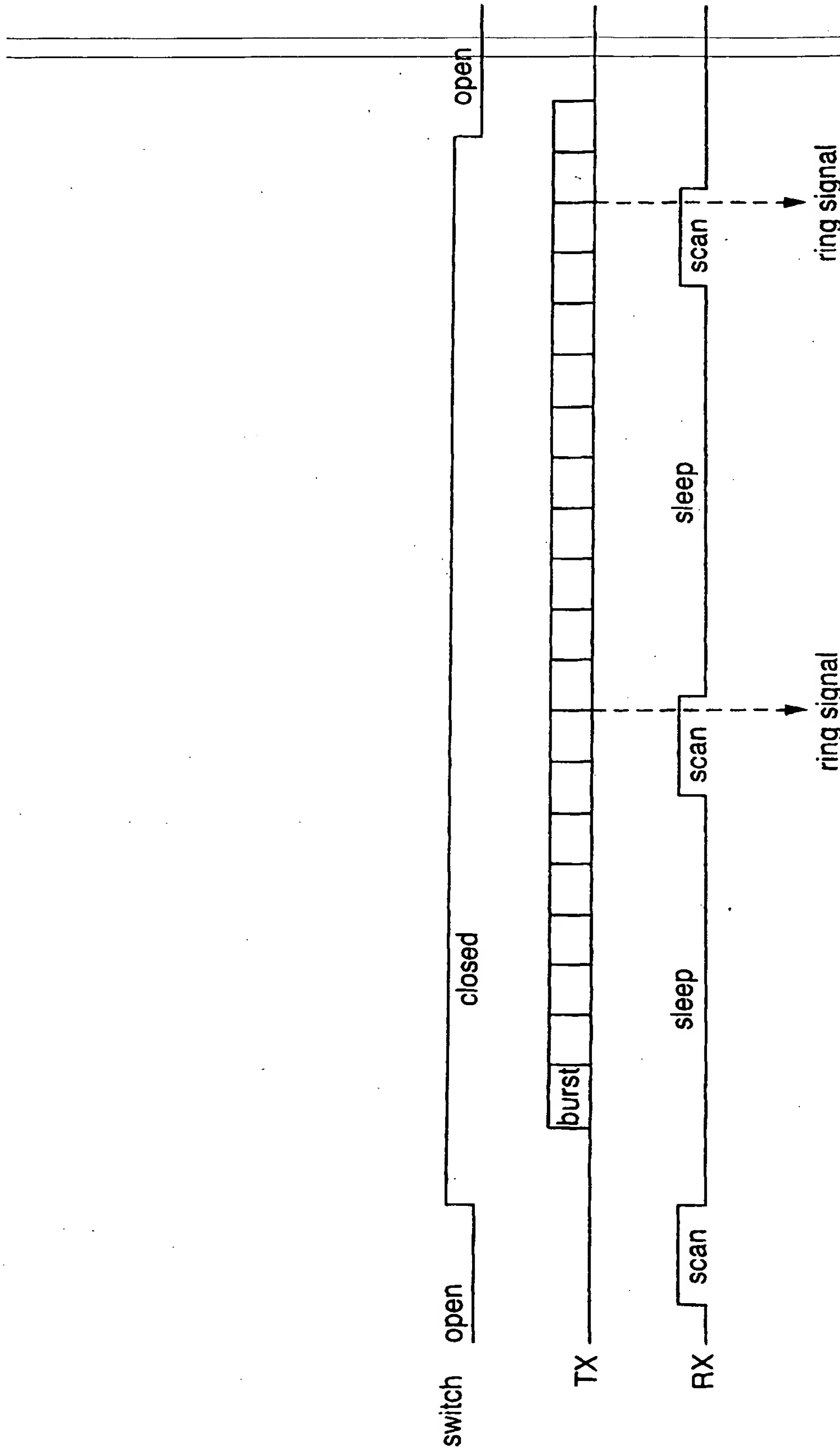
Cellular air interface
50
40
Phone Transceiver
45
MMI
46
Audio Unit
47
48
Speaker
MIC
49
Mobile communication device
Phone Control
44
Correlator
43
Receiver
42
41
33
32
30
Transmitter
31
Vdd
Portable tracking device

Fig. 2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closed
open
TX
burst
RX
scan
sleep
scan
ring signal
sleep
scan
ring signal

Fig. 3

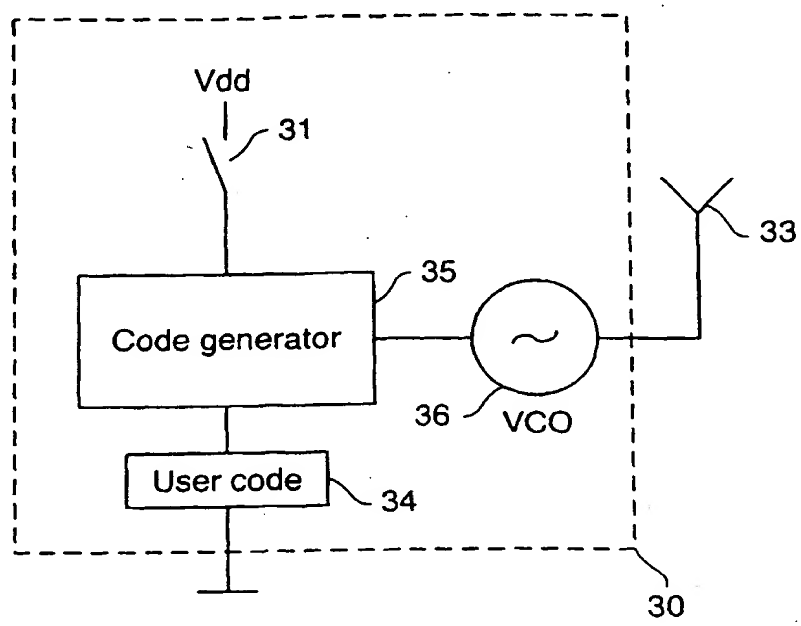
Vdd
31
33
35
Code generator
36
VCO
User code
34
30

Fig. 4

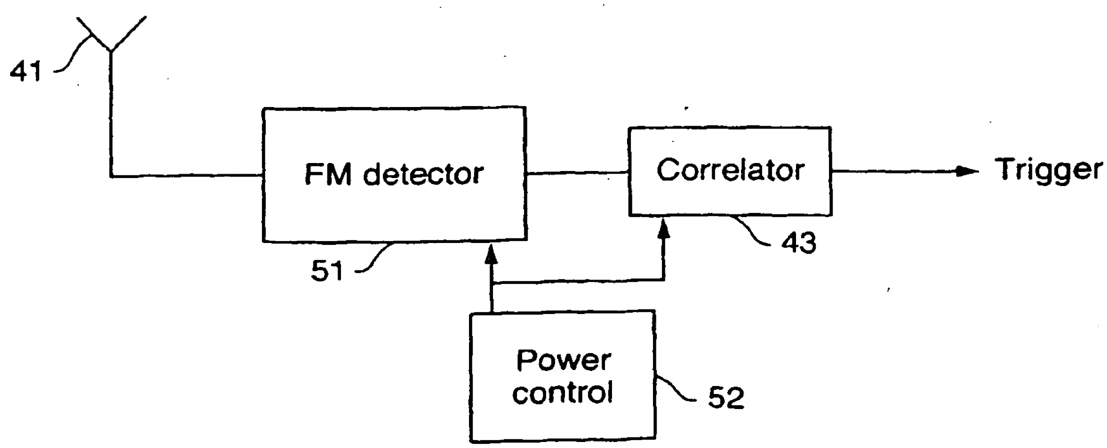
41
FM detector
Correlator
Trigger
51
43
Power control
52

Fig. 5

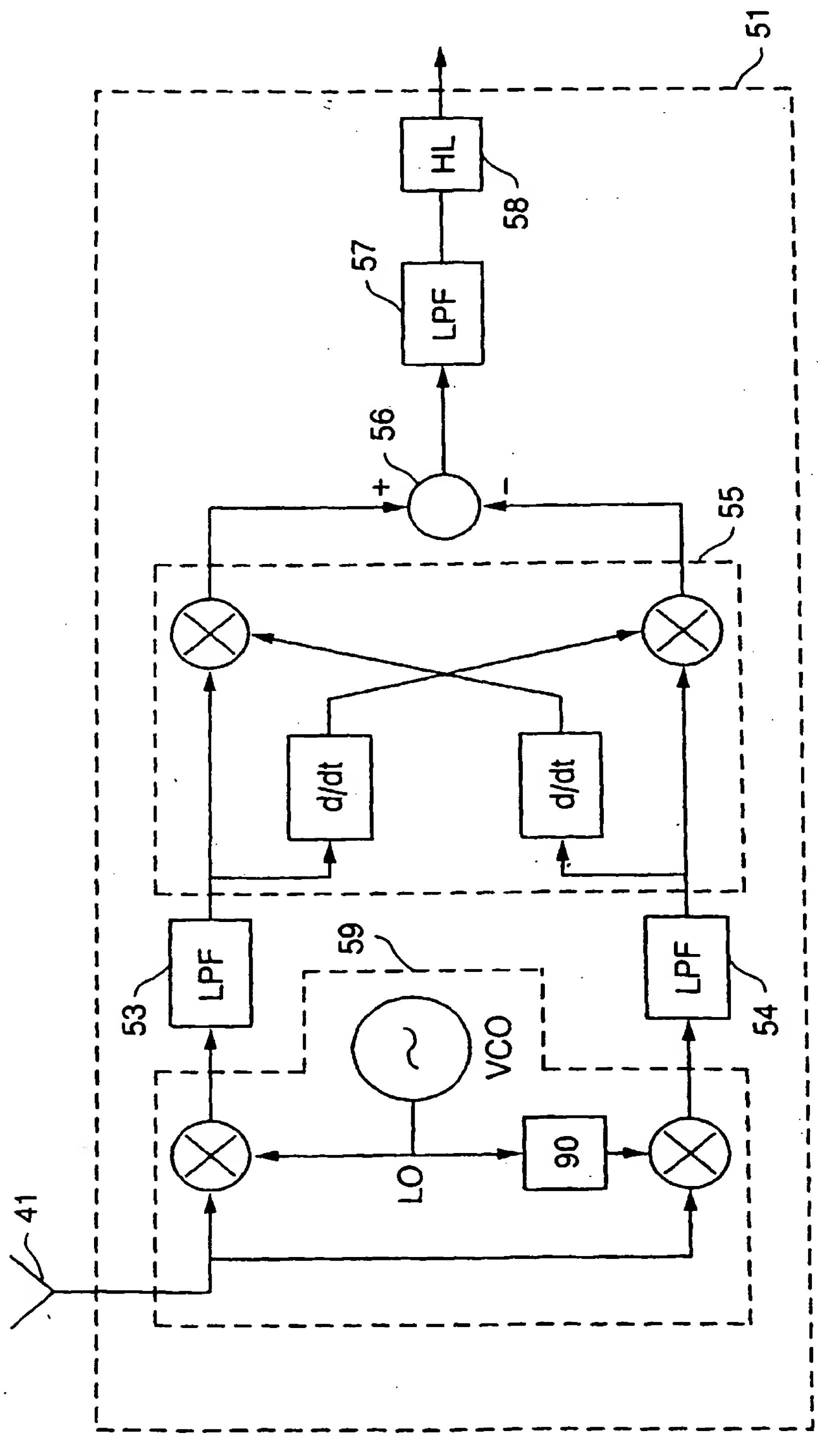

Fig. 6

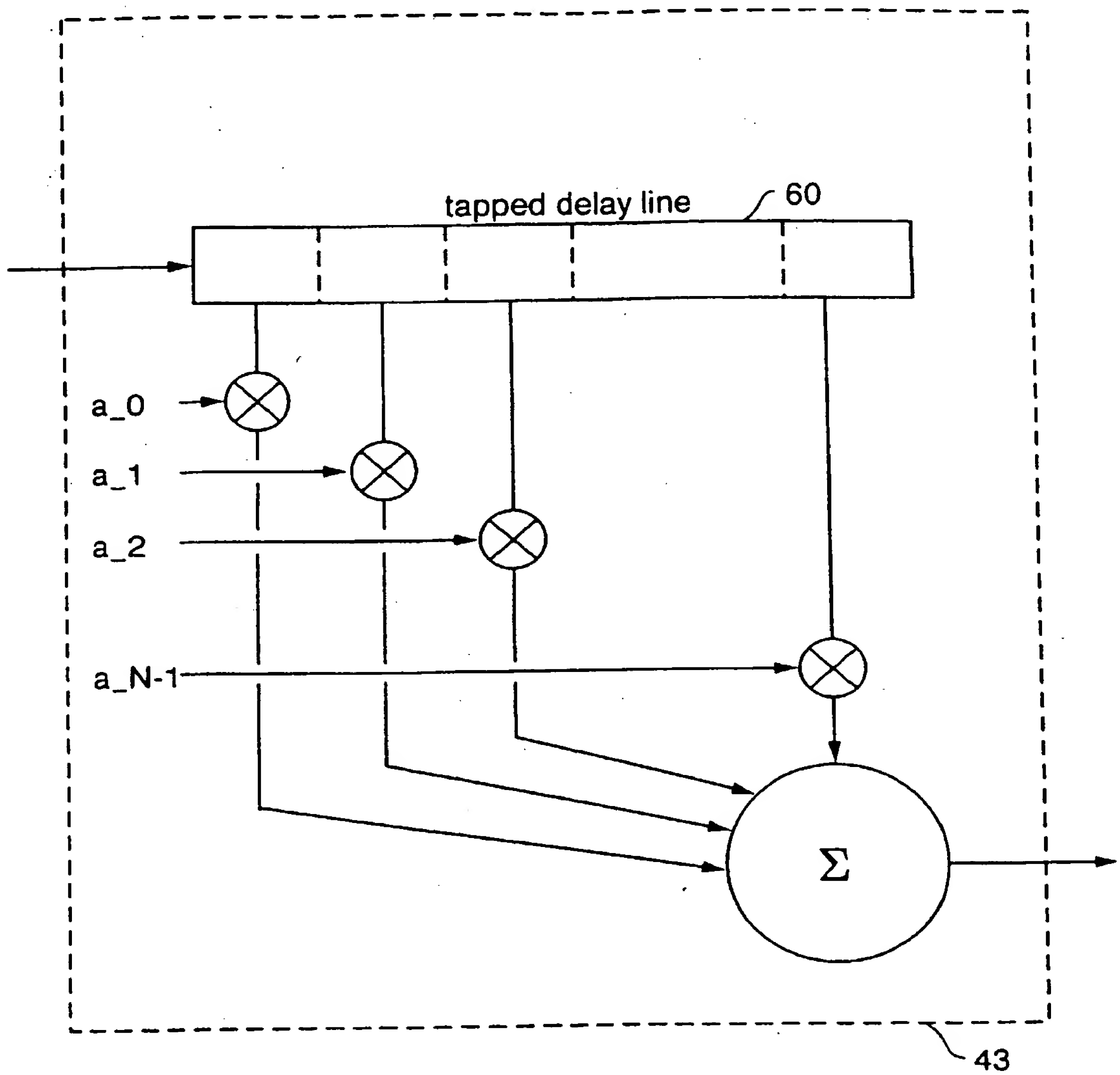

Fig. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 85 0102

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 089 667 A (NYIRI T. W.) * page 4, line 1 - page 8, line 18; figures 1,2 *	1-4,7-10	G08B21/00
X,D	US 4 101 873 A (BENJAMIN E. A.) * column 1, line 1 - column 3, line 32 *	1,2,7,8	
X	US 5 638 050 A (SACCA F.) * column 2, line 65 - column 4, line 7; figures 1-5,7 *	1,2,7,8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			G08B

ORIGINAL NO MARGINALIA

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 November 1997	Sgura, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

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